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ABSTRACT

The Applied Computer Science Department at Illinois State University is in the process of implementing a reengineered curriculum that utilizes an integrated and spiral approach to subject coverage. The 1996-97 school year was the first year that upper division course prerequisites were based on the new curriculum instead of a mixture of old and new. During this first year, professors taught upper division courses that relied on students having acquired the knowledge and skills from the first portion of the spiral. This paper focuses on the systems analysis and design component of the core, including systems development tools and database concepts, and the way in which the introduction of this material in a first, core course impacted the more advanced treatment of the topics in advanced courses for Information Systems majors. Issues and problems are analyzed, attempted solutions discussed, and suggestions offered for those faced with a similar situation. After teaching the two follow-on courses, it was apparent that more planning and development work needs to be done in order to affect a smoother transition along the spiral. (Author/AEF)

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A SPIRAL APPROACH TO TEACHING DATABASE AND SYSTEMS DEVELOPMENT: THEORY VS. REALITY

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The Applied Computer Science Department is in the process of implementing a re-engineered curriculum that utilizes an integrated and spiral approach to subject coverage. The 1996-97 school year was the first year that upper division course prerequisites were based on the new curriculum instead of a mixture of old and new. During this first year, the authors taught upper division courses that relied on students having acquired the knowledge and skills from the first portion of the spiral. This paper will focus on these upper division courses and the articulation issues and problems that arose when trying to teach them. These issues and problems will be analyzed, attempted solutions discussed and suggestions offered for those faced with a similar situation. After teaching the two follow-on courses, it was apparent that more planning and development work needs to be done in order to affect a smoother transition along the spiral.

INTRODUCTION

The Information Systems program in Illinois State University's (ISU) Applied Computer Science Department (ACS) has over 500 majors. The Department also houses a Telecommunications program and has recently added a Computer Science component. All of these programs rely on a common core of courses within which material essential to continued study in any of the areas is introduced. The focus of this paper is the systems analysis and design component of the core, including system development tools and database concepts, and the way in which the introduction of this material in a first, core course impacted the more advanced treatment of the topics in advanced courses for Information Systems majors.

Due to the dynamics of technology and the field of Information Systems in general, the department has been involved for many years in curriculum revision. This multi-year effort resulted in a re-engineered curriculum in 1994. The department is currently completing the process of implementing the re-engineered curriculum. Due to catalog commitments to (then) current students we could not simply cut-over to our new curriculum upon its approval. Rather we had to support the previous curriculum for a number of years and phase in the new curriculum for incoming students. As a consequence of this need for dual support, there were a couple of years during which instructors were given some flexibility in their approach to certain courses, so that the particular backgrounds of the enrolled students could be taken into account. In the case of the courses discussed in this paper, students in either the advanced systems analysis and design course or in the upper-division database course may or may not have had a lower-division course, which introduced some of the methods and concepts relevant to database and systems development.

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The 1996-97 school year was the first year that upper division course prerequisites were based on the new curriculum instead of a mixture of old and new curricula. The faculty had understood that, due to the phased implementation, the program and the students would not gain the benefits of the re-engineered curriculum until all of the courses in the old curriculum were completely phased out. Thus mismatches in course articulation during this period were expected and did not raise extraordinary concern.

The re-engineered curriculum (1) utilized an integrated and spiral approach in designing subject coverage. The start of the spiral for database and system development has been described in Chrisman, 1996 (2). This school year the authors taught upper division courses that relied on students having acquired the knowledge and skills from the first portion of the spiral.

The spiral approach to subject coverage is based on the idea that knowledge and understanding expands through multiple interconnected levels of understanding. Thus when a student is introduced to new material, it is taught in a context which relates it to other known material at the level at which that material is understood. As a result while various topics will receive a complete contextual treatment the first time they are introduced to the student, they may not receive a topically detailed treatment. The intent of this approach is to provide a framework and understanding prepatory for the time at which the topic will be revisited later in the curriculum.

At the time of the writing of this paper our students are completely within the redesigned curriculum. Consequently, the issues and problems which occur in teaching the upper division courses can not be attributed to the need to support requirements from both the old and the new curricula. This paper will focus on these upper division courses and the issues and problems that arose when trying to teach them. These issues and problems will be analyzed, attempted solutions discussed and suggestions offered for those faced with a similar situation.

PRE-SEMESTER PREPARATION

Under the circumstances, the upper division course in systems development was viewed as if it were a new course. Our previous course in systems analysis and design both introduced systems development tools and methods and required students to carry out the analysis and design of a live project. Additionally it was followed by a course in technical design that had been eliminated in the new curriculum in favor of multiple alternative courses dealing with various technologies and implementation-level issues. Our new upper division course was to rely on most of the modeling methods and concepts as prerequisites. This would allow more time for project management and other project-related issues.

In planning for the course, the instructors of the prerequisite course were consulted, copies of all related course material were reviewed and possible textbooks were obtained. As this information was reviewed, it became obvious that there would be a problem in coordinating and managing the transition to the upper division direct follow-on course. Based on our understanding of the first course's content and coverage of subject matter, a general topic outline for each week of the 300-level system development course was developed. The next step was to find a suitable textbook. Issues in this area of textbook selection encompassed the following items:

1. the need to find a text that covered the topics in the outline at an appropriate level.
2. students' perception of the uniqueness of this particular course.
3. the extent of the overview coverage of the previous course.

After much deliberation, we worked with a publisher to customize a text for the course.

We found that the situation with textbooks presents a unique challenge to using the spiral approach in teaching the courses included in the spiral. Most systems analysis and design textbooks try to provide a complete, linear, treatment of each covered topic, e.g. modeling technique, using a single-pass approach. In our case, the lower division course had, in fact, selected such a text. In some sense the students had already "seen it all", even though they had not been required to read all of the sections of each chapter in the text. One option was to re-use

the same text that had been used in the lower-division course. But the challenge would have been to get the student to understand that we were advancing to a new conceptual level. They had used a text that would allow an instructor to completely cover the material at an advanced level (or not). In the end, we decided that to ask the students to use the same text but re-read it with a different perspective would be unwise.

The option of using another standard systems analysis and design text had its drawbacks as well. By definition, such textbooks are very much alike. Perhaps there are pedagogical reasons to select one over another, but we felt that the students would not see it quite that way. We wanted the students to approach the material with a fresh perspective, and not as if it were a rehash of their previous course.

As a consequence of these factors, we tailor-designed a text from multiple sources. We hoped that by tailor-designing the text, it would play the role of a coherent body of material that would supplement the students' previous text. In this way the advanced course could compare methods and approaches and involve the students in a discussion of the relative merits of one approach over another. The students would also have access to a broader resource base while doing their projects.

Review of the text and syllabus for the lower-division course also highlighted another concern. Most current systems analysis and design texts provide "A to Z" coverage of the field. Obviously such a text provides a framework for extensive coverage of a topic but leaves open the possibility that the instructor may have more limited goals. As a result, it is very difficult to determine depth of coverage or expectations by looking at topic or syllabus coverage. By the time of this cut-over, seven different instructors had taught sections of the lower-division course. We were left with a number of problems: Did the textual material identify the maximum extent of actual topic coverage in class or had instructors used this as a framework to relate more advanced material based on their (e.g., consulting) experience? Had classroom discussions pushed some of the instruction to the level of issues expected to be covered in the upper division courses? On top of this how did all of the various instructors deal with these things individually? As a result of these questions, follow-on instructors were caught in the switches trying to identify a good starting/continuation point for the advanced classes as a whole.

One thing that became apparent as we reviewed the situation was the need for close coordination at the sequence level not just at the individual course level. Within the Department, it has been the practice to assign one faculty member teaching a course with multiple sections, the responsibility of being course coordinator. However, in this situation where the intent is to engage in the spiral approach to topic coverage in a sequence of courses, it may be appropriate to also assign a sequence coordinator.

The 300-level database course did not receive the same scrutiny since it was not considered to involve as dependence and overlap with the 200-level course. In fact, it was thought that just shortening the lecture time with certain topics and starting at a slightly advanced level would suffice.

There were many important similarities between the two upper division courses. The major homework assignments involved project work which was different from the homework assignments in the 200-level course. It was thought that the real-world nature of the projects and the extent of the development life cycle coverage coupled with the level and extent of topics covered in lecture would enable students to attain a significantly higher skill level than they had attained in the earlier course.

COURSE EXPERIENCE

As we commenced the semester, we naively thought that after selecting a text book, deciding on major homework/project assignments and familiarizing ourselves with the coverage, both topic and level, in the 200-level course that we had addressed and resolved major issues/problems with these two courses. Very quickly, it became apparent that for many of the students in the upper division courses that there was a vast difference in what the previous course's instructors and syllabus indicated was covered and what the students' acquisition, remembrance, and perception of topics covered was.

Perhaps it is only natural for students to disclaim knowledge of a topic in the hopes that the instructor will refresh their memories and delineate exactly the material for which they are to be held accountable. We found that students in the upper-division courses were very quick to claim either that they had never been introduced to certain material or that it had only been covered in passing. Very often queries to their previous instructors indicated that the students were simply mistaken on the details. They had covered the material; they just had not been exposed to it in the same context that students from other sections had been. Consequently they perceived this sort of material as "completely new". Given the combinations of sections feeding the advanced courses, the frequency of this sort of complaint was very high. Of course some of the complaints turned out to be accurate. In either situation, however, the result was pretty much the same. Either some time had to be allocated in the upper-division course to get everyone on the same "page", or a large portion of the class was going to be operating at a disadvantage.

The spiral approach the department designed had not intended to duplicate the first course material in the second, but rather to build on the former in the latter. Where the second course built on methods covered in the first, it was intended to do so by dealing with the practical application of the methods. Any time spent covering the lower-division material in the upper-division course adversely impacted the amount of material which could be covered in the latter.

We did find that where the students perceived that they understood various methods and techniques coming into the course they expressed a higher level of comfort with the project assignment than previous groups of students had. The systems analysis and design class, for example, was divided into 5-6 person teams. The team as a whole would have a higher level of confidence than in previous years. Since some members of the team felt confident of the methods and techniques learned in the lower-division course this ability was available to the team as a unit. Of course team members worked with each other to bring each up to speed, and this accelerated the learning activity.

Given the assumption that the lower-division course had established certain fundamentals, the upper-division course focussed on the applied nature of the material. With the time bought by covering modeling in the lower-division course, it became possible to spend more time than usual on project management. Classroom lectures stressed the flow and interaction between various activities within the lifecycle, as opposed to teaching, e.g., stand-alone model development. Of course as these topics were being covered, the live project reinforced the lecture material.

In the 300-level database course, the students' perception of the material covered varied more that expected. In fact, the prior coverage of material was different because of a curriculum sequence that hadn't been adequately considered. The database course actually serves two distinct groups of students. It is the direct follow-on database course for the undergraduate core course on database and system development. In addition, it may be the first database course for graduate students. Graduate students are required to take at least one of two database courses. At this level, graduate students without sufficient database experience or prerequisites for the 400-level database course take the 300-level database course.

Some students who had taken the undergraduate sequence complained that there was too much overlap and not enough new material in the course. However, in some areas which students had flagged as having dual coverage, students did not demonstrate the expected level of understanding or competence. For example, in the area of data modeling, a topic first introduced in the 200-level course in some detail, students did not demonstrate the level of expertise to be able to develop an entity-relationship model for a practical situation. The expectation is that students learn the fundamentals of data modeling in the 200-level course and then develop the ability to apply the concepts in the 300-level course. The problem was to develop this ability to apply the concepts without seeming to repeat the material covered in the earlier course.

In an attempt to address this particular problem, the instructor of the database course met with students to discuss and review a revised syllabus and presentation approach. This semester, topics that have been covered previously are not addressed in the "standard lecture format" as they have been. Instead problems have been

selected that require students to use the various modeling techniques in developing a data model for the particular problem or scenario. In implementing this approach, two slightly different methods have been used. In one case, the class has been divided into three groups and different problems are assigned to each group. The group develops a solution and then presents and discusses it in class. In the other case, all students are given selected problems as homework. Then the instructor discusses the problem and presents various solutions. So far students seem to be able to handle the simpler more straightforward problems. However, in the case of richer more complex problems, it is often necessary for the instructor to conduct the discussion. This general approach seems to be working; at least, it involves the students and encourages them to more active in the learning process. One problem with this approach is that the lectures are not as structured so that it is difficult to ensure similar coverage in multiple sections or to document the coverage that actually takes place. In addition, the open discussion is very dependent on the instructor's level of experience and expertise. Another problem is the amount of class time required to develop the discussion and to cover the topic area in this manner.

The former students were in favor of this method of presentation and strongly recommended it. However, it remains to be seen how the students currently experiencing the different approach will evaluate it and what level of competency they will acquire.

For students coming into the course with alternate courses or experience used to satisfy prerequisites, a special attempt was made to recommend outside supplementary readings and to make available a multimedia presentation on the basics of data modeling.

CONCLUSIONS

After teaching the two follow-on courses, it is apparent that more *planning and development* work needs to be done in order to affect a smoother transition along the spiral. It is also apparent that textbook selection for the involved courses also becomes an item of concern in the articulation between the courses. The paper has discussed the procedures being used to attain a better articulation between the courses and to monitor the ongoing process as well as suggesting some additional procedures that could be used.

Articulation between courses and instructors, especially in a large program, is very difficult. The individual strengths of various instructors play to articulation difficulties. On the positive side, instructors convey the material in which they have a high level of expertise to their students exceptionally well. On the negative side, this more 'horough coverage can contribute to shorting the time and depth of coverage for material which the instructor finds less interesting, for whatever reason.

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